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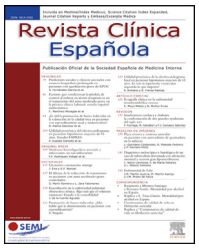

ORIGINAL ARTICLE

Epidemiology of COVID-19 among health personnel in long-term care centers in Seville☆

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Abstract
Background: Coronavirus disease 2019 (COVID-19), caused by SARS-CoV-2 infection, spreads swiftly in nursing homes and assisted living facilities, leading to a high degree of lethality. The data generated by an epidemiological surveillance program allow for obtaining valid information on the diseases' epidemiology and possible prevention methods.
Objective: This work aims to analyze COVID-19 epidemiology among healthcare staff based in the Seville healthcare district (Spain) and evaluate its role in outbreaks in nursing homes.
Methods: This is an observational, descriptive study of 88 assisted living facilities located in the city of Seville from March 1 to May 23, 2020. Data were obtained via epidemiological surveys on staff at centers where there were outbreaks (n = 732 in 14 nursing homes). The cumulative incidence, epidemic curves, sociodemographic and clinical characteristics, and delays in isolation and notification of cases were calculated. For the statistical analysis, measures of central tendency and dispersion were used as well as confidence intervals and statistical hypothesis tests.
Results: There were 124 cases in staff members (cumulative incidence 16.9%), 79.0% of which were in women. The majority presented with mild symptoms (87.1%). The most common symptoms were fever (31.5%) and cough (49.2%). The median number of days from onset of symptoms to isolation was three.
Conclusions: A high incidence in nursing home staff along with delays in isolation were observed, which could affect the dynamics of transmission in outbreaks. It is necessary to review disease identification and isolation practices among staff as well as emphasize rapid implementation of prevention measures.

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PALABRAS CLAVE
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Epidemiología de la COVID-19 entre el personal de centros sociosanitarios de Sevilla

Resumen
Antecedentes: La infección por coronavirus SARS-CoV-2 se transmite rápidamente en residencias de mayores y centros sociosanitarios, provocando una elevada letalidad. Los datos generados por el programa de vigilancia epidemiológica permiten información válida sobre la epidemiología del problema y las posibilidades de prevención.
Objetivo: Analizar la epidemiología de la infección por COVID-19 entre los profesionales sociosanitarios del Distrito Sanitario Sevilla y su papel en la evolución de los brotes en las residencias de mayores.
Metodología: Estudio sobre 88 centros sociosanitarios de la ciudad de Sevilla en el período del 1 marzo al 23 mayo de 2020, partiendo de las encuestas epidemiológicas en casos del personal donde hubo brotes (n = 732 en 14 residencias). Se calcularon incidencias acumuladas, curvas epidémicas, características sociodemográficas y clínicas, y demoras en el aislamiento y notificación de los casos. Para el análisis estadístico se emplearon medidas de tendencia central y de dispersión, así como intervalos de confianza y pruebas de contraste de hipótesis.
Resultados: Se produjeron 124 casos en trabajadores (tasa de ataque 16,9%), 79,0% en mujeres. La gran mayoría presentaron síntomas leves (87,1%). Los comunes fueron fiebre (31,5%) y tos (49,2%). La mediana de días desde el inicio de los síntomas hasta el aislamiento fue 3 días.
Conclusiones: Se objetiva una elevada incidencia en el personal sociosanitario con demoras en el aislamiento que pudieron condicionar la dinámica de transmisión en los brotes. Es necesario revisar las prácticas de identificación de la enfermedad y el aislamiento entre el personal, énfasis en la implementación rápida de medidas de prevención.

Introduction

The pandemic caused by the new SARS-CoV-2 coronavirus has had a massive impact on nursing homes and assisted living facilities given the concentration of individuals with heightened care needs and the situation that comprises the institutionalisation of the elderly and of fragile patients[1,2]. An increase in hospitalisations and deaths due to COVID-19 has been observed with age, particularly starting at the age of 80. In Spain, mortality has reached 13.9% in the 70-79 age group and 21.1% in those over 80. This difference has also been demonstrated in the number of hospitalisations, with 72.9% in the first group and 53.9% in the latter, since the onset of the pandemic up to 4 May, 2020[3].

The risk of infection increases with close contact and even more so with prolonged contact and in closed spaces and, as occurs in these assisted living facilities, in the presence of employees from different cohabitation environments. Added to these circumstances are specific conditions that hinder the control of transmission given that care for the elderly is based on direct contact and interpersonal interaction[4–6]. In addition, outbreaks have been described following social, familial, or workplace events among workers[7].

In the city of Seville, epidemiological surveillance of nursing homes and assisted living facilities was a priority from the start of the pandemic, with the first nursing home case declared on 15/3/2020. From that point forward, actions were taken in accordance with the recommendations for these resources as issued by the Health Department[8,9]. Starting on 23 March, strict measures were established for checking the temperatures and symptoms of both workers and residents, visits and outings were suspended, and common areas were closed off and different areas established for infected and uninfected residents[10]. On 3 April, the Andalusian Department of Health and Families published an order to provide ongoing medical care and to adapt centres with active outbreaks and specific circumstances such as clinical decline of patients, lack of healthcare staff, or lack of infrastructure, to ensure adequate isolation[11].

The Health District's Public Health Unit implemented a specific program to control and trace infections among healthcare workers in these types of care facilities. The very first outbreaks brought to light the potential role of workers in the mechanisms of transmission, with screening for and active observation of symptoms representing an essential component. This program included early case identification, thorough information collection, advising on surveillance and control measures, support for processing temporary disability leave, as well as a specific consultation phone line. Similarly, written recommendations were sent to the directors of long-term care centres regarding the importance of active symptom detection, including taking and recording temperature and responsible declaration of a lack of symptoms prior to starting shifts.

To date, there are few studies on the characteristics and roles of healthcare workers in COVID-19 epidemiology. The data generated by the epidemiological surveillance program and by the outbreak control mechanism made it possible to obtain valuable information about the context of the

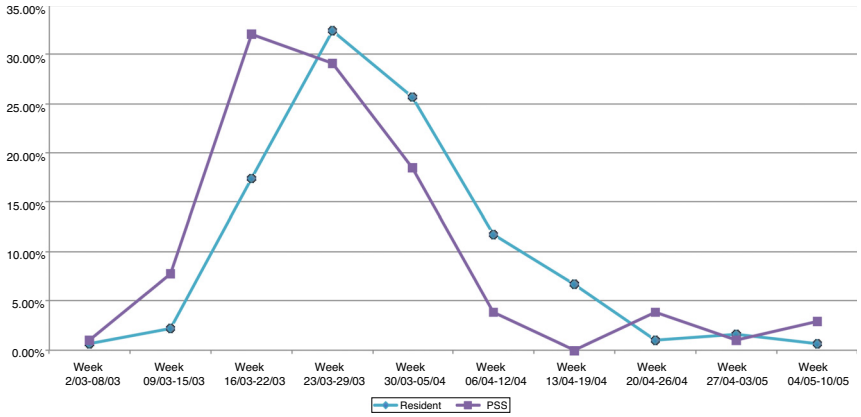

Figure 1 Epidemic curve for PSS and residents (relative frequency).

pandemic. This study aims to describe the epidemiological characteristics of COVID-19 among health professionals from the Seville Health District, assessing their role in the temporary evolution of infection in the facilities that experienced outbreaks.

Methodology

An observational, analytical study was conducted on the epidemiological characteristics of infection by SARS-CoV-2 among healthcare workers (PSS according to the Spanish acronym) during the period between 1 March and 12 May 2020. The label of PSS was given to any individual dedicated to health, social, and educational assistance for groups of older individuals or individuals with disabilities, including staff from external companies (cleaning, maintenance...) who came into contact with residents.

Information sources included the daily tracking logs from the facilities regarding case detection (Andalusian care strategy) and the RedAlerta epidemiological surveillance program. RedAlerta includes variables from the Andalusian Epidemiological Surveillance System (SVEA according to the Spanish acronym) regarding the characteristics of the cases, data from epidemiological surveys, and actions related to controlling outbreaks.

Following definition of the study variables, a file was created with anonymised personal data, ensuring safety and protection regulations throughout the entire process.

As a starting point, we took the 88 centres included in the District program of nursing homes and long-term care centres located in the capital city of Seville (34 nursing homes for the elderly; 31 foster care centres; 18 religious congregations and 5 care centres for the disabled), with 2,779 active workers. A total of 732 PSS was included, corresponding to 14 centres with at least one case of COVID-19 and which the case management nurses actively traced, identifying the appearance of compatible symptomatology and collecting the positive results of the rapid antibody tests. Afterwards, cases were isolated, and a PCR test was performed. The definition of cases followed the procedures of the Ministry in force at all times: any PSS that presented a positive PCR test or positive rapid antibody test.

In the initial phase, all the workers were screened to discover the prevalence of total antibodies in the city's PSS. In the second phase, we collected all the information on the incident cases in the residential centres where a COVID-19 outbreak had been declared.

The following variables were collected: age, sex, professional category, confirmed close contact with COVID-19, hospitalisation, death, presence of risk factors, symptomatology and dates for symptom onset, isolation, case declaration, and test results.

To know the prevalence of SARS-CoV-2 antibodies in this population, two rounds of screening were conducted using rapid antibody tests via immunochromatography, with 7 days difference between the tests to reduce the possible window period effect of the infection. To calculate the incidence of COVID-19 in the outbreak-affected centres, PCR tests were performed on positive cases found in the screening, as well as those PSS who developed symptoms compatible with the disease during the study.

Frequency tables were used to analyse the qualitative variables, and measures of central tendency and dispersion for the quantitative variables, including the interquartile range. The prevalence of antibodies to SARS-CoV-2 was calculated in the entire sample. In the facilities affected by outbreaks, the following were calculated: cumulative incidence of COVID-19 cases in PSS, attack rate, and average number of days that the workers attended work with symptoms. The epidemic curves of the COVID-19 cases were created for both PSS and residents (Fig. 1).

Results

Rapid antibody tests were performed on 2,779 PSS from 88 facilities, of which 78.6% were female and 21.4% were male (femininity index of 368.03%). In this first screening phase 40 workers were detected with a positive result, of which 26 (65%) reported having symptoms compatible with COVID-19 in the epidemiological survey.

During the study period, outbreaks occurred in 14 centres, with 732 PSS. A total of 79.0% were female and the median age was 33.5 years (interquartile range: 27-45). According to professional category, 39.7% were nursing aides; 17% geriatrics assistants; 8.7% cleaning staff; 5.7%

Table 1 Attack rate in PSS by long-term care centre.

Long-term care centre	No. of cases	Workforce	Attack rate	CI (95%)
A	44	122	36.1%	27.4-44.7
B	23	110	20.9%	13.2-28.6
C	18	68	26.5%	15.7-37.2
D	11	62	17.7%	8.0-27.5
E	8	24	33.3%	13.0-53.7
F	7	57	12.3%	3.5-21.1
G	6	103	5.8%	1.2-10.4
H	1	40	2.5%	−2.6-7.6
I	1	30	3.3%	−3.5-10.2
J	1	21	4.8%	−5.2-14.7
K	1	18	5.6%	−6.2-17.3
L	1	19	5.3%	−5.8-16.3
M	1	11	9.1%	11.2-29.3
N	1	47	2.1%	−2.2-6.4
Total	124	732	16.9%	14.2-19.7

CI: confidence interval.

nurses; 1.7% physical therapists, and 1.3% doctors. Cases also occurred in other categories of lesser proportion such as cooks, concierge, maintenance, receptionists, and social workers.

In the study period, a total of 124 cases of COVID-19 were confirmed among the PSS, representing a cumulative incidence of 16.9%. A total of 90 cases were confirmed by PCR and the rest by means of rapid antibody tests. As seen in Table 1, only one case occurred among PSS in 7 of the 14 centres. The attack rates ranged from 2.1%-36.1%, and 3 facilities had a percentage of affected staff of more than 25% of the PSS. The attack rate among the residents was 54.3% with a range of 18.4%-79.8%. There is a correlation between the number of PSS and the attack rate (unilateral, $p < 0.05$, Spearman's rank correlation of 0.484). This analysis is not confirmed if we divide the facilities between those with more or less than 50 PSS due to the small number of facilities.

Of the 90 cases detected by PCR, 7 (7.7%) were identified via a prior positive antibody test (4 of them acknowledged having had symptoms compatible with COVID-19). Table 2 presents the data for the 7 outbreaks declared in the Seville district that presented more than one case among the PSS and which represent 94.3% of the total declared cases.

Of the confirmed cases, 87.1% presented symptomatology. The most common symptoms included cough (49.2%), fever (31.5%), headache (25%), anosmia (19.4%) and asthenia (18.5%). The least frequent symptomatology was dyspnoea, present in 8.1% of cases. A total of 17.7% presented a risk factor for COVID-19, with the most common being high blood pressure and chronic lung disease with 8.5% prevalence, followed by age of over 60 with 4.8%. A total of 5.6% required hospitalisation and no deaths occurred. All cases recovered without sequelae.

In terms of the distribution over time, the week from 16 to 22 March had the highest incidence for symptom onset date (5.12%) and the week from 23 to 29 March the highest incidence for date of case declaration (3.91%) (Fig. 2).

Regarding the delay between symptom onset and isolation, this was greater than 10 days for multiple weeks. The delays until case declaration are somewhat longer, though these follow a similar pattern (Fig. 3).

Lastly, the curves for symptomatic PSS cases and those for residents in the affected centres are shown, according to the symptom onset date. The first case in PSS started showing symptoms on 2 March, while the first declared case did not occur until 17 March. The highest peak was on 19 March in PSS and 25 March for residents (Fig. 1).

The case rate was one PSS in 3 facilities. In another facility, 2 different waves can be discerned, with the first starting on 17 March with one case among the residents and the second on 21 April with one case among the PSS. From 31 March to 20 April, no residents or PSS started to experience symptoms.

Discussion

This study shows the high impact of COVID-19 in long-term care centres in Seville during the period from March to May 2020, in which 14 out of 88 centres in the district were affected, with an attack rate of 54.3% among residents in centres with outbreaks. The healthcare workers group was also particularly affected, with an attack rate of 16.9% in centres with outbreaks. While the cumulative incidence is similar between men and women, in absolute terms the impact is higher in female workers as this sector is highly woman dominant. The proportion of cases in women is around 75%, which is very similar to the data published by the Ministry of Health for cases among health professionals[12].

A significant percentage of the affected staff attended work with symptoms, which could have conditioned the speed and spread of infection. The majority of cases presented at least one of the characteristic symptoms of COVID-19, despite delays in isolating and declaring the cases. The little knowledge of the disease at the time, difficulty to access diagnostic tests, and strain on staff are

Table 2 Clinical and demographic characteristics of confirmed cases in PSS by nursing home associated to outbreak.

	A (N = 44)	B (N = 23)	C (N = 18)	D (N = 11)	E (N = 8)	F (N = 7)	G (N = 6)	Total (N = 124)
Median age (IQR)	30.5 (25.2-37)	34 (27-52)	35 (27.2-53)	44 (39-57)	37 (30.5-52)	40 (30-45)	24.5 (21-33)	33.5 (27-45)
Mean (SD)	32.7 (9.9)	38.5 (15.1)	38.9 (13.1)	44.0 (12.3)	39.7 (11.8)	38.8 (7.6)	26.5 (6.1)	36.8 (12.2)
Sex								
Female, n (%)	40 (90.9)	17 (73.9)	11 (61.1)	8 (72.7)	7 (87.5)	7 (100)	4 (66.7)	98 (79)
Symptomatic, n (%)	38 (86.4)	19 (82.6)	17 (94.4)	10 (90.9)	5 (62.5)	7 (100)	5 (83.3)	108 (87.1)
Fever, n (%)	14 (31.8)	7 (30.4)	5 (27.8)	4 (36.4)	1 (12.5)	2 (28.6)	2 (33.3)	39 (31.5)
Cough, n (%)	25 (56.8)	11 (47.8)	10 (55.6)	6 (54.5)	3 (37.5)	3 (42.9)	1 (16.7)	61 (49.2)
Dyspnoea, n (%)	6 (13.6)	2 (8.7)	1 (5.6)	0	1 (12.5)	0	0	10 (8.1)
Feverish, n (%)	6 (13.6)	2 (8.7)	1 (5.6)	1 (9.1)	1 (12.5)	1 (14.3)	0	13 (10.5)
Headache, n (%)	16 (36.4)	2 (8.7)	1 (5.6)	6 (54.5)	3 (37.5)	2 (28.6)	1 (16.7)	31 (25)
Vomiting/diarrhoea, n (%)	3 (6.8)	2 (8.7)	3 (16.7)	1 (9.1)	0	1 (14.3)	1 (16.7)	12 (9.7)
Odynophagia, n (%)	5 (11.4)	3 (13)	2 (11.1)	3 (27.3)	1 (12.5)	2 (28.6)	0	18 (14.5)
Anosmia/ageusia, n (%)	10 (22.7)	2 (8.7)	1 (5.6)	2 (18.2)	2 (25)	2 (28.6)	3 (50)	24 (19.4)
Asthenia/myalgia, n (%)	9 (20.5)	4 (17.4)	0	4 (36.4)	2 (25)	1 (14.3)	2 (33.3)	23 (18.5)
Risk factors, n (%)	3 (6.8)	7 (30.4)	5 (27.8)	3 (27.3)	1 (12.5)	1 (14.3)	1 (16.7)	22 (17.7)
Hospitalisations, n (%)	5 (11.4)	0	1 (5.6)	0	0	1 (14.3)	0	7 (5.6)
Diagnosis PCR, n (%)	29 (65.9)	18 (78.3)	17 (94.4)	6 (54.5)	4 (50)	7 (100)	5 (83.3)	90 (72.6)
Diagnosis test, n (%)	15 (32.6)	5 (21.7)	1 (5.6)	5 (45.5)	4 (50)	0	1 (16.7)	34 (27.4)

IQR: interquartile range; PCR: polymerase chain reaction; SD: standard deviation.

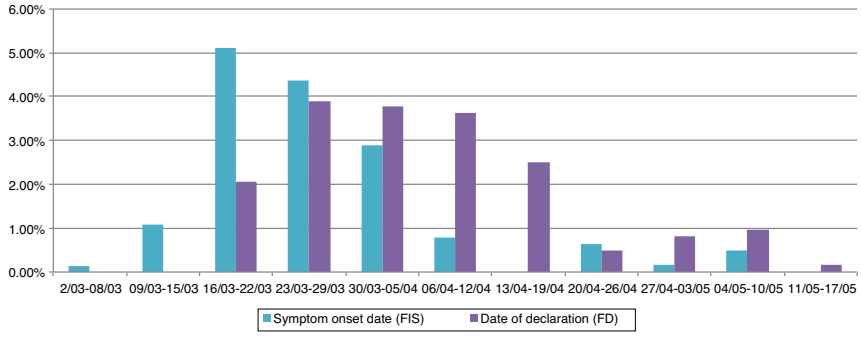

Figure 2 Distribution of PSS cases by weeks and cumulative incidence.

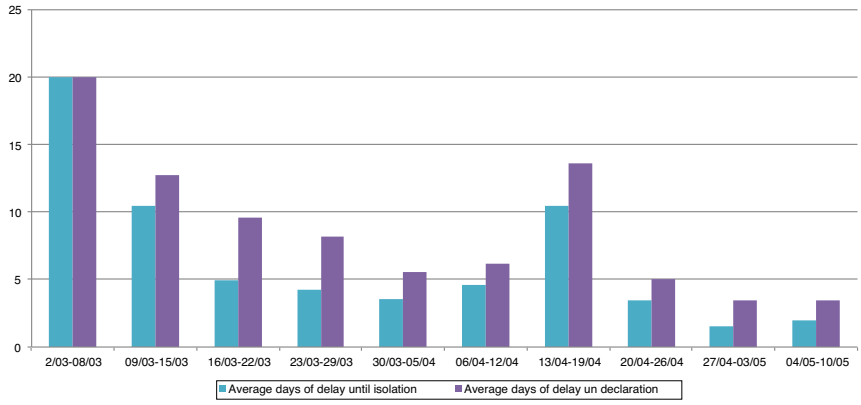

Figure 3 Mean number of days of delay between: symptom onset date (FIS) and isolation; FIS and declaration of PSS cases.

considered the causes behind this diagnostic delay. All of this was aggravated by the complicated definition of occupational disease in terms of temporary disability leave.

These data coincide with the studies conducted in the hospital environment which show infection rates in workers ranging from 9% to 29%, with delays exceeding 2 days and symptomatology similar to that already described[13–20]. The facilities with the highest incidence among PSS and residents were affected during the first fortnight of March 2020, with the incidence subsequently slowly decreasing. This decrease over the course of the study period coincided with the improvements established within the Health Department's control program and can be attributed to the learning and adoption of preventive measures, as well as enhanced surveillance and early detection of cases.

Multiple studies have reported the significant role of unrecognised asymptomatic and presymptomatic infections as a contributing factor to transmission in these environments[16,21]. These studies conducted screening in the context of the outbreaks, finding that over half of the residents or workers with positive tests were asymptomatic[16,17,22,23]. Consequently, interventions that could improve control would include early identification of potential cases by broadening the criteria for case suspicion and symptom detection, increasing the use of testing with regular screenings, and making it easier to process temporary disability leaves due to illness[20]. Similarly, notifying the health authorities to establish emergency measures and the swift implementation of intervention have been shown to be key in reducing transmission in facilities and in controlling COVID-19 outbreaks[4].

Study limitations include difficulty in collecting data given the state of emergency due to the pandemic, which could have affected the reliability of some of the variables. Uncertainty in remembering exact dates could have affected the recording of onset of symptoms and their characteristics with mild symptomatology. The high variability in the clinical picture of this disease, as well as a reticence to declare cases, causes patients with mild symptoms to potentially go unnoticed. A number of diagnoses were made using antibody tests that were later confirmed to have low sensitivity and specificity, but given that the proportion of these cases is low, it is assumed that it should not alter the overall results.

In short, the high incidence of infection by SARS-CoV-2 among healthcare workers was a deciding factor in the appearance of outbreaks in long-term care facilities, as well as in the intensity and duration of transmission. This situation mainly occurred during the initial weeks of the pandemic when there was little knowledge of the disease and little access to tests. Currently, the high vaccination coverage accomplished in these centres has achieved indirect protection for even those residents who have not been vaccinated. Even with this strategy, it is necessary to expand upon measures that improve labour and working conditions, providing training in the prevention of infection transmission and management of temporary disability associated with COVID-19[23–25].

Promoting prevention programs for the new coronavirus will result in better global control of infections with regards to long-term care centres.

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Conflicts of interest

The authors declare that they do not have any conflicts of interest.

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